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Patents Form 1/77

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09JUL04 E910120-1 B16800
P01/7700 0.00-0415409.2 NONE

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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1. Your reference
LAMINA

2. Patent application number *(The Patent Office will fill this part in)*
0415409.2

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
MR QUINTIN ANTHONY MURFIN
ROSEWOOD
LA LONGUE RUE
ST MARTIN
JERSEY
JE3 6ED
GREAT BRITAIN

Patents ADP number *(if you know it)*
8727760001

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention
SUSTAINABLE SURFACE WATER MANAGEMENT SYSTEM

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*
THE GLEN
BEACH ROAD WEST
PORTISHEAD
BRISTOL
BS20 9HX

Patents ADP number *(if you know it)*
8890683001

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?
NO

Answer YES if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
Otherwise answer NO (See note d)

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	0
Description	5
Claim(s)	0
Abstract	0
Drawing(s)	4 + 4

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for a preliminary examination and search (Patents Form 9/77)

Request for a substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Q. A. Mergin

Date 8/7/2004

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

RICHARD CLARK
01275 843904

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b) Write your answers in capital letters using black ink or you may type them.

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f) Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

SUSTAINABLE SURFACE WATER MANAGEMENT SYSTEM

Background of the Invention

The present invention relates to sustainable surface water drainage. Sustainable Urban Drainage Systems (SUDS) is a term that refers to drainage systems that are environmentally sustainable rather than those that require the removal and remote treatment and disposal of large quantities of water using sewers and treatment processes. Typical devices of on site water management are swales and infiltration basins.

The objective of SUDS is to reduce the volume of surface water requiring disposal to the adjoining aquatic environment.

The need for SUDS arises when large surface areas are paved such as roads, car parks, airports, distribution centres and the like. These surfaces are described herein as pavements. They are normally required to support loads imposed by human activities such as pedestrians, motorcars and commercial vehicles.

Impermeable Roof runoff is also a contributor to surface water runoff.

Technical problems

Outdoor paved surfaces for human activities generally increase the runoff of surface water following rainfall compared to vegetated surfaces. This runoff is greatest at times of high rainfall storm events and needs to be managed to prevent flooding of the surface, adjoining areas and potentially downstream areas within the receiving catchment. Flooding can cause damage to property and inconvenience. Human activities such as vehicle washing can also apply volumes of water to a pavement.

Pollution of the aquatic environment by water drained from pavements is also a problem. Many pavements are subject to the deposition of pollution. Pavements for vehicular use, such as road carriageways, car parks and airports and those used for industrial activity generally produce some form of pollution that is carried off the surface by precipitation or wash down generated water runoff. The pollutants carried off the surface can pollute the catchment, or, to mitigate this, require the treatment of large quantities of surface water with relatively low pollution levels with an associated cost generally in proportion to the volume.

Spillages of chemicals on the surface of pavement may also cause polluted runoff to the adjoining aquatic environment and cause pollution unless controlled by closed storage containment systems.

In vegetated surfaces the organic soil structure detains some of the water derived from precipitation which is returned to the atmosphere by evaporation from the soil surface and the transpiration of plants. This process has a climatic influence. Most paved surfaces are designed to minimise the surface absorption of rainwater to minimise winter icing risks. Thus the paving of surfaces has a micro climatic effect. Only a small proportion of rainfall does not runoff paved surfaces because it is

absorbed in the surface and evaporates off after the rainfall event due to the action of wind generated airflow and solar heat gain during daylight.

Prior Art Solutions

Professor Pratt of Coventry University has described a paving system for spillage and flood management in WO96/12067, equivalent to GB-A-2294077 and US-A-6146051. This system is an example of an infiltration basin and uses a perforated pavement that covers a deep substrate of mainly hard nodules or shells, which is contained within impervious walls in order to form a tank. Water is stored within the substrate and can be discharged from an outlet in the base of the tank.

The Pratt tank reduces peaks in the outlet flow and enables the chemical or biochemical treatment of spillages within the substrate.

Structural components for the assembly of a SUDS system for use with a permeable pavement include synthetic geocellular structures such as those available from SEL Environmental under the trade marks PERMAVOID (R.T.M) for perforate, polypropylene box units and PERMACEPTOR for an interception, attenuation and treatment facility.

These systems all envisage the use of a permeable pavement and some form of outlet to the natural aquatic environment.

The role of evaporation in the disposal of rainwater has been considered by Professor Pratt in a paper given to The Chartered Institution of Water and Environmental Management Midlands Sustainable Urban Drainage Systems Symposium part 2 on 31 January 2001, in which it is acknowledged that field data generated by Mantle in 1993 (in an unpublished thesis at Nottingham Trent University entitled "On Site Reduction and Attenuation of Urban Stormwater Runoff") has shown that a permeable pavement construction may evaporate significant amounts of water.

Evaporation as a method of disposing of treated water is described in US4039451 (Smith Alvin Jack). However this is a system to which a supply of water is separately piped rather than being located beneath a pavement. The described evaporation bed has an exposed surface.

Solution of the Invention

In accordance with the present invention it has been appreciated that by enhancing evaporation of water incident on a pavement and, where necessary applying water management processes, it is possible to create a system that can be designed without an outfall in order to eliminate surface water runoff contribution to flooding or pollution to the adjoining catchment. With an outfall, the system of the invention can minimise storm flows to adjoining receiving waters and reduce the volume of polluted runoff that requires disposal.

The present invention provides a storage cell, or cells, for receiving water from a pavement defining the upper boundary of the cell, a remaining boundary being

defined by a water impermeable layer, characterised in that the cell further comprises elements that detain water in contact with ventilated pathways enhancing evaporation.

Preferably the evaporation enhancement comprises the creation of water detaining liners, suspended dished panels, absorbent mats or particulate material with surface absorbency characteristics in contact with air pathways that are connected to the atmosphere outside of the pavement.

Preferably the mats are made of non-woven geotextiles with a capillarity property that detains water for the full depth of the mat in combination with a surface texture that is conducive to the evaporative process.

A plurality of airways is incorporated in the structure connecting to the atmosphere at the surface of the pavement or at surfaces beyond the pavement that may be elevated by utilising flue pipes. These pathways allow the atmospheric processes of the flow of air, which when less than fully saturated, is able to take up water from the contacting wet surfaces and discharge this water load to the atmosphere above the pavement.

Spillages of chemicals on the surface of the pavement will enter and be fully contained by the system where constructed without an outfall and may be removed by lifting out the polluted water by pumping following an incident or, if acceptable, by later removal when the polluted water volume in the cell has been reduced by evaporation. Providing a plurality of discrete cells with individual draw off points may be desirable to contain spillages within individually smaller volumes of water. The use of modular units is beneficial in this respect,

At sites where the soil below the structure has the capacity to take in water by infiltration into the soils, the boundary of the system in contact with the soil may, alternatively, be a water permeable geotextile with a pore size that prevents the migration of fines from the soil into the structure. Infiltration to ground will be appropriate only where the pollution incident on the surface the pavement is able to be degraded by the biodegradation process on the surface of the pavement and by passage through the structure of the system sufficiently to produce an acceptable inflow quality to the soil for aquifer protection.

Water in excess of that lost to evaporation is stored within the pavement and may be disposed of by harvesting the water for plant watering, domestic grey water use, or drainage to watercourse. In the case of drainage to watercourse, the outfall may be at a level in the structure that allows attenuation of the flow and dilution of pollution by the stored water to occur within the structure. Evaporative enhancement will help to emulate the evapotranspiration /infiltration balance that prevails in an equivalent vegetated surface.

Accordingly, the System consists of a paved surface course or open grid that is capable of supporting the human activities that the surface is intended for (e.g. pedestrians, motor cars, commercial vehicles) which has drainage perforations that allow surface water to drain from the surface down into the cell which overlay a water impermeable liner supported by adjacent soils (or structures) or which overlays a water retaining structure. The cell incorporates features that retain water and have contact with ventilated pathways to allow evaporation to occur. Ventilated pathways

connect to the air space above, or adjoining the paved surface and allow water taken up by the air in those pathways to be transmitted and discharged to the atmosphere, hence reducing the volume of water in the cell.

Periodically, water that remains unevaporated in the cell is drawn off and this smaller quantity of distillate containing a concentrated level of pollution is disposed of by an appropriate treatment process. Where levels or pollution are lower and the biodegredation occurring in the cell renders the water suitable for re-use for plant watering, grey water or other appropriate use these uses can be made.

The system can be designed to have no outfall to the adjoining aquatic environment.

Infiltration to ground of water that has been improved by biodegredation within the system may also be possible in some cases.

Evaporation may also be increased by heating the water stored in the cell or by mechanically forcing ventilation.

Detailed description of the invention

Preferred embodiments of the invention are shown on the following drawings:

FIGURE 1 shows a cross section through a surface vent and flue system
FIGURE 2 shows a cross section through a surface vent system
FIGURE 3 shows a cross section through a surface grid system
FIGURE 4 shows a cross section through a surface vent voided stone system

In Figure 1 a permeable paved surface course 1 (e.g. permeable block paving)is supported by a particulate bedding layer 2 (e.g. gravel) if required which has a geosynthetic evaporation mat 3 below. The pavement and mat is supported by a structural grid 4, which spans between perforated walls or columns (such as synthetic geocellular structures) that rest on the system liner and subgrade. The pavement and structural grid are designed to be able to support the intended surface activity traffic (e.g. pedestrians and vehicles) and remain serviceable for the design life of the structure by conventional pavement design and structural design methods.

Additional geosynthetic mat 3 layers supported by a structural grid 4 may be positioned below the first mat separated by ventilation airways. Alternatively, the lower geosynthetic evaporation mats can consist of a sheet with dished dimples formed in its surface to store water in discrete units for evaporation.

Following rainfall, rainwater drains through the permeable paved surface course 1 and optional particulate bedding layer 2. Some water will be absorbed by the surface course 1 and optional particulate bedding layer 2. This water will evaporate to the air above the surface over time. Some water will drain to the geotextile mats 3. These thick mats are of the non-woven type that will absorb and retain water between the mat fibres. This water will over time evaporate from the surfaces contacting with air in the air pathways. Where the geotextile mat 3 is level it will hold water over its entire horizontal extent. Where the mat is inclined the extent may need to be limited to ensure that water is held by capillary action over its extent rather than draining

from the more elevated extend of the mat, dependant on the capillary properties of the geotextile mat utilised.

Airflow through the air pathways in the structure is increased by the draw of the flue pipes 6 set at internals around the edge of the pavement and surface vents 7. The flue pipes 6 may be fitted with cowls that are designed to increase the wind generated airflow rate. Forced ventilation may also be utilised.

The base of the system has a liner 9 giving rise to a retained water level 8 when water inflow into the system is sufficient to saturate the upper layers of the system and drain to the liner . Alternatively the liner 9 may be a permeable geotextile allowing infiltration to the sub-grade where the water quality reaching the soil interface is sufficient improved by biodegradation within the system to be acceptable for infiltration to the soil.

In Figure 2 a similar system is shown, with the exception that there are surface vents at intervals across the pavement or at the periphery of individual modular units. The paved portion between the vents may be permeable allowing recharge of the geotextile mats 3 or impermeable, in which case the lower mats are omitted and evaporation from the cell stored water only is utilised.

Where the system consists of individual modular units, the units are connected together to ensure continuity of water retention and to cascade flow between units laid to falls by overflow links just below the pavement material level.

In Figure 3 a similar system is shown, however, the pedestrian/vehicle surface is an open grid flooring allowing ventilation over the entire surface supported by perforated cross walls or columns such as synthetic geocells. Geosynthetic mats panels which have air spaces around them to allow ventilation may be added to the design of the cell.

In Figure 4 a system of a permeable paved surface course 1 over a particulate bedding layer 2 on an open graded particulate material layer 10 supported by synthetic geocellular units that act as ventilation pathways. The particulate material absorbs and adsorbs water on its surface and has interconnecting voids allowing air to circulate.

The system should be designed and managed to ensure that the stored water level does not overtop the lowest point of an impermeable liner 9 or saturate the particulate bedding layer 2 when the pavement is in vehicular service.

Design of the cell storage should suit the climate of the locality.

Design should allow for the reduction in storage volume over time due to the ingress into the system of fine material from the surface activities and windblown silts.

Any contribution from adjoining impermeable surface such as impermeable pavements and roof areas draining to the pavement should be accounted for in the design.

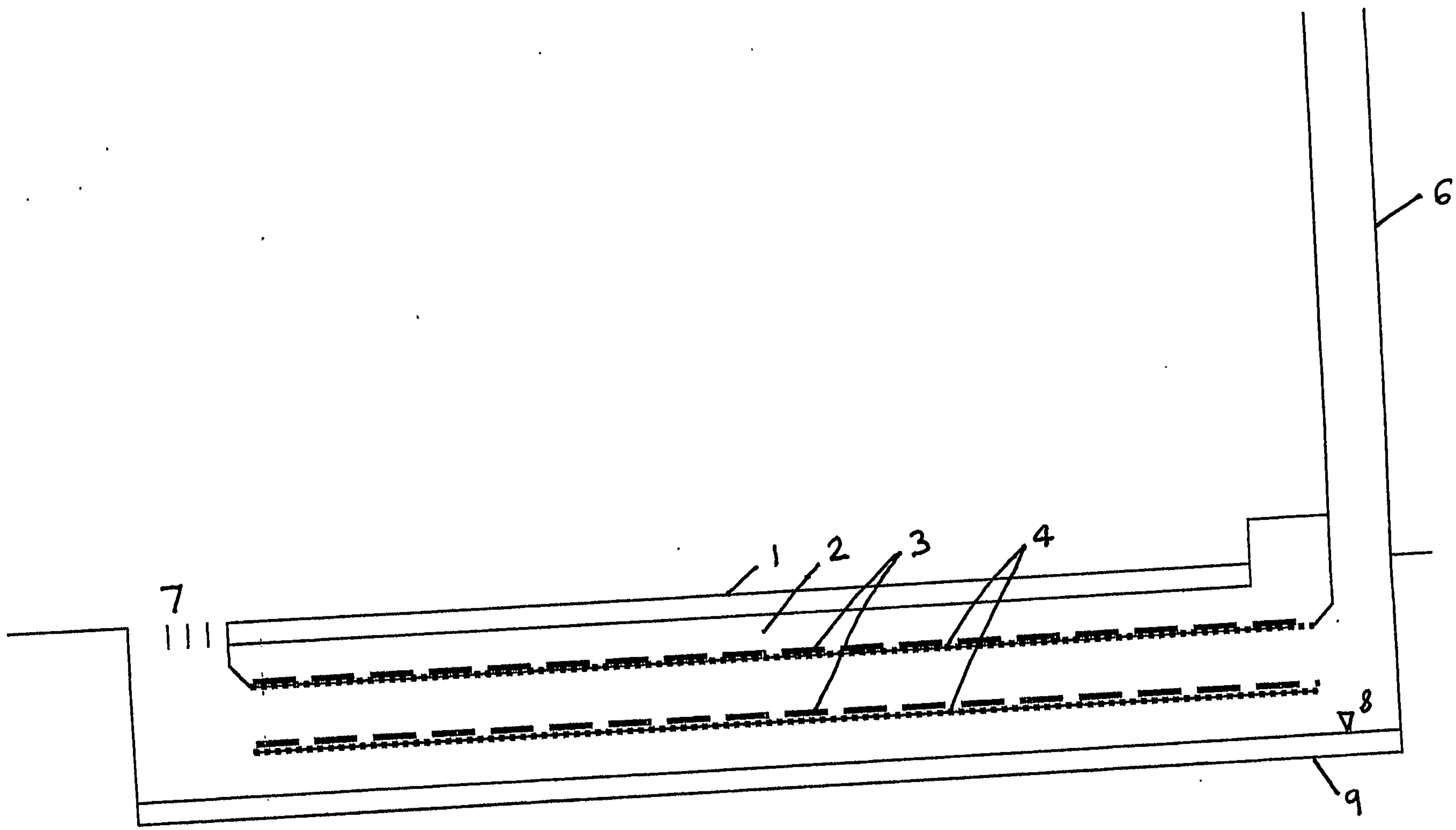

FIGURE 1

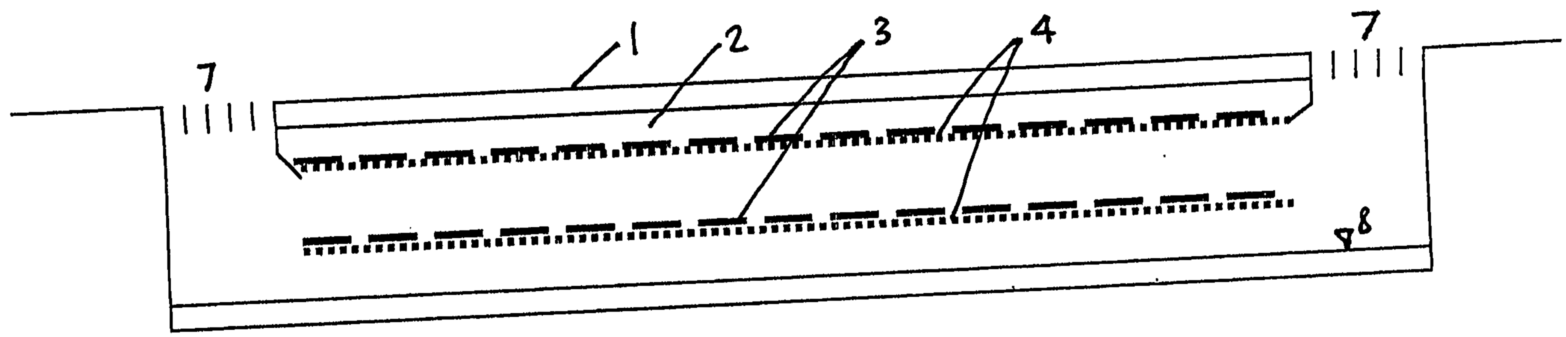

FIGURE 2

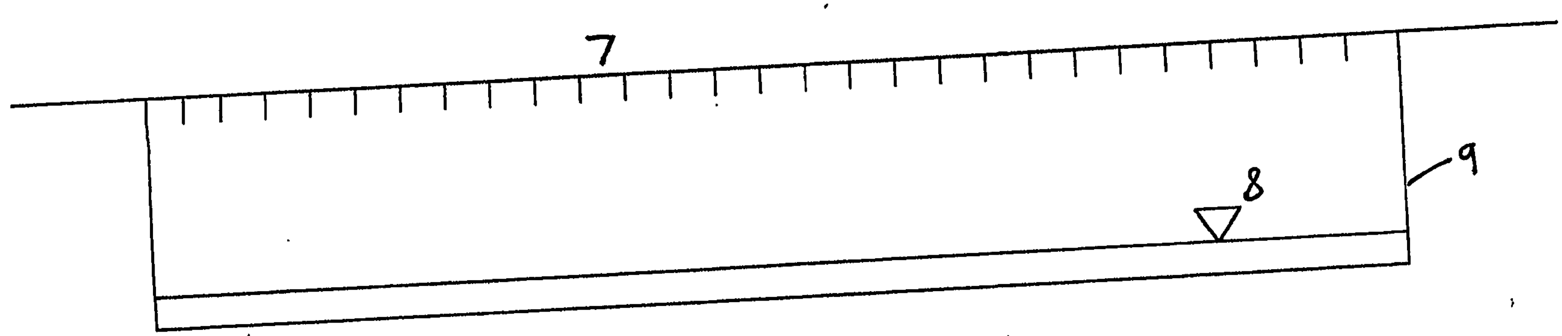

FIGURE 3

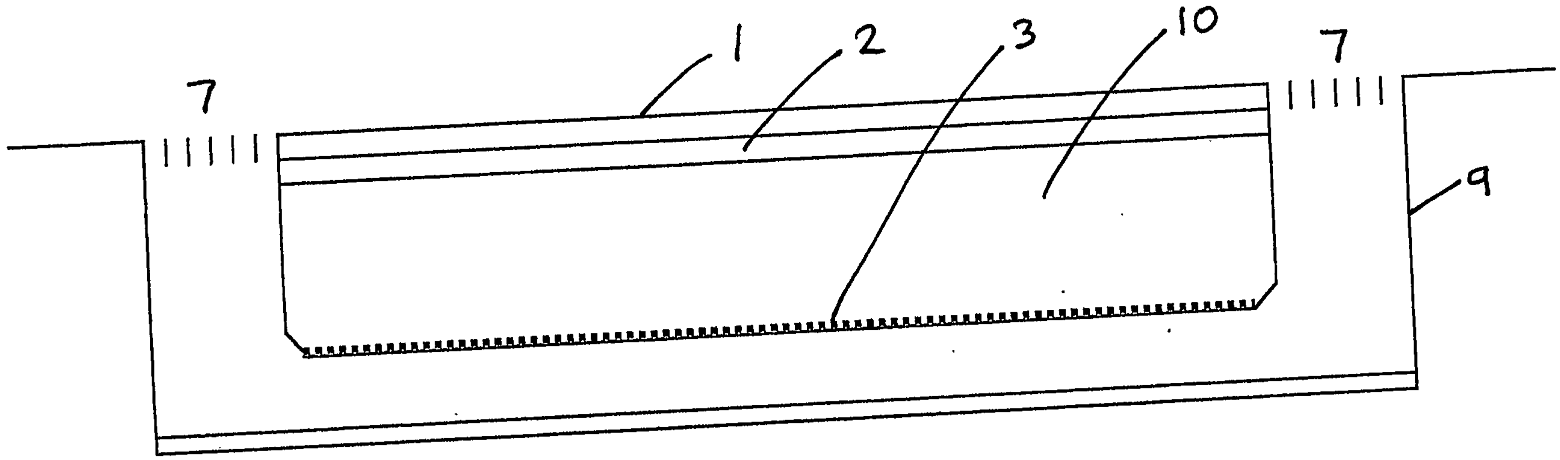

FIGURE 4